

<https://helda.helsinki.fi>

---

## Communal farmers of Namibia appreciate vultures and the ecosystem services they provide

Craig, Christie

2018

---

Craig , C , Thomson , R & Santangeli , A 2018 , ' Communal farmers of Namibia appreciate vultures and the ecosystem services they provide ' , Ostrich , vol. 89 , no. 3 , pp. 211-220 . <https://doi.org/10.2989/00>

---

<http://hdl.handle.net/10138/245178>

<https://doi.org/10.2989/00306525.2018.1435566>

---

acceptedVersion

---

*Downloaded from Helda, University of Helsinki institutional repository.*

*This is an electronic reprint of the original article.*

*This reprint may differ from the original in pagination and typographic detail.*

*Please cite the original version.*

# Communal farmers of Namibia appreciate vultures and the ecosystem services they provide

CA Craig<sup>1</sup>, RLThomson<sup>1</sup>, A Santangeli<sup>2</sup>

*<sup>1</sup>FitzPatrick Institute of African Ornithology, DST-NRF Centre of Excellence, University of Cape Town, South Africa*

*<sup>2</sup>The Helsinki Lab of Ornithology, Finnish Museum of Natural History, University of Helsinki, Finland*

**Key words:** cultural use, attitudes, local knowledge, beliefs

Ecosystem services are cited as one of the many reasons for conserving declining vulture populations in Africa. We aimed to explore how communal farmers in Namibia perceive vultures and the ecosystem services they provide, with special focus on cultural and regulating ecosystem services. We surveyed 361 households across Namibia's communal farmlands and found that over two thirds of households liked vultures and found them useful, stating that they were harmless and useful for locating dead livestock. The minority of households who disliked vultures believed that they were killing their livestock. Because vultures rarely kill any prey, this may be a misconception. Poisoning was the main cause of vulture mortalities reported by farmers. While poisoning appears to be a major concern for vultures in the communal farmlands, it appears that cultural use of vulture body parts is a minimal threat. We found that few farmers knew of cultural beliefs about vultures or uses for body parts, most farmers believed these beliefs and practices to be outdated. It is further promising that communal farmers have an overall positive perception of vultures. This highlights the potential for communal conservancies to bring attention to vulture conservation in their constituencies.

## **Introduction**

Ecosystem services are defined as the benefits that people can get from individual species and ecosystems as a whole (Diaz et al. 2015). This concept is one that appeals directly to human interests and it is increasingly used to underpin the rationale for conserving biodiversity. With the rapid global decline of vultures, scientists have begun to quantify the ecosystem services that vultures provide to humanity (Donázar et al. 2016). The relationship between humans and scavengers has been evolving since the Late Pliocene, when humans first used vultures to find meat to scavenge on (Moleón et al. 2014). Today this relationship continues, studies show that many farmers make use of vultures to find their dead livestock in the field (Reson 2012; Santangeli et al. 2016; Morales-Reyes et al. 2017). Vultures are obligate scavengers and are more efficient in removing carrion than any other vertebrate group (Houston 1986; Devault et al. 2003; Ogada et al. 2012a; Sebastián-González et al. 2016). Vultures consume carrion before diseases can spread and also prevent other opportunistic scavengers such as hyenas, feral dogs and rats from capitalising on this food source (Markandya et al. 2008; Ogada et al. 2012b). These opportunistic scavengers are known carriers of pathogens such as rabies and bubonic plague. If the fecundity of these species increases due to increased carrion availability and they are interacting at carcasses more frequently, this could have implications for disease transmission (Markandya et al. 2008; Ogada et al. 2012b). For example, following the crash of Asian vultures, there was a marked increase in the number of feral dogs and as a result the incidence of rabies increased (Prakash et al. 2003; Markandya et al. 2008).

Vultures also provide cultural ecosystem services, such as aesthetic experiences, spiritual reflection and enjoyment (Milcu et al. 2013). For example, some African cultures use vulture body parts in traditional medicine for the purpose of giving the user clairvoyance and luck

(Beilis & Esterhuizen 2005; Mckean et al. 2013). This may, albeit controversially, be described as a cultural ecosystem service. The cultural value of vultures to communities is an integral aspect to consider. Cultural beliefs about species can be both beneficial and detrimental to conservation goals. Some beliefs and taboos can protect a species or ecosystem (Colding & Folke 2001), such as the sacred groves revered by Hindu people in Uttarakhand, India, which protect portions of the forest from exploitation (Anthwal et al. 2010). While other beliefs can be harmful for a species, for example in Africa where harvesting of vultures for their body parts increases the pressure on already decreasing vulture populations (Williams et al. 2014; Ogada et al. 2016). Reson (2012) and Pfeiffer et al. (2014) have provided some insights into the cultural value of vultures in the Maasai and Xhosa culture, respectively. However, little is known about the cultural importance of vultures to other rural communities in Africa. These studies, as well as Santangeli et al.'s (2016) study with Namibia's commercial farmers, have shed light on the relationship that people in Africa have with vultures. However, in general, these topics have, so far, received little research attention. In this study, we contribute to this body of knowledge by investigating how communal farmers in Namibia perceive vultures and the ecosystem services they provide.

Five of Africa's Critically Endangered and Endangered vultures reside within Namibia to some extent (Simmons et al. 2015). The primary threat that vultures face within Namibia is feeding upon poison laced carcasses which farmers put out to target predators that kill their livestock (Botha et al. 2012; Simmons et al. 2015; Santangeli et al. 2017). Consequently, farmers have a vital role to play in reducing threats and conserving vultures. One of the first steps to inspire behavioural changes in communities is to raise awareness on the value of vultures and the causes of their decline (Costanzo et al. 1986; Stern 2000; Schultz 2012). Before these initiatives can be effectively implemented, baseline knowledge on how farmers

perceive vultures and what they know about them should become available. This knowledge will facilitate development of conservation initiatives which are relevant to the communal farming system in Namibia.

In terms of the cultural value of vultures to Namibian farmers, some information on the cultural use of vulture parts was provided by a survey in central Namibia (Hengari et al. 2004). They asked seventeen sangomas (witch doctors) about the use of vulture parts in their trade and found that nesting material was the most popular item on sale, followed by the brain and feathers. This study gives some insight into the supply of vulture parts (Hengari et al. 2004). However, we know little about the demand for vulture parts from rural people.

We aimed to describe the knowledge and cultural value of vultures among the subsistence farmers living in the communal areas of Namibia. Specifically, we investigated the local knowledge that communal farmers have regarding the general ecology of vultures, i.e. their main diet, their population trends. Local knowledge is defined as the body of knowledge, belief and practice which evolves and is passed down through generations about the relationship between humans and the natural environment (Berkes et al. 2000; Diaz et al. 2015). Here we explore farmers' local knowledge of vultures, reporting information regarding the beliefs and cultural uses of vultures and their body parts among communal farmers. We quantify the attitudes that communal farmers have towards vultures, and how they value the services that vultures provide. Lastly, we assess the main threats to vultures in the communal areas by asking farmers to report on any vulture mortalities that they had witnessed.

## Methods

We conducted surveys with communal farmers in central and northern Namibia, excluding the Caprivi and Kavango regions. The location of the homestead was recorded at the farm or pointed out by the farmer on a map if we were not at the farm. Locations have been kept confidential to protect the identity of the farmers, however we provide an indication of sample density to show the coverage of the area (Fig. 1). All surveys took place between September and December 2016. We took the survey unit as the household, in some cases we would survey one person representing the household and in other cases multiple people in the household contributed to the same survey simultaneously. A concern with this method is that people influence one another's answers. While this is a drawback, a benefit of surveying multiple members from the household is that people tended to feel more comfortable and share more details. On average, surveys took 21 minutes, ranging between 7 and 53 minutes. Most households surveyed were situated within communal conservancies (Fig.1). Communal conservancies, first legislated in Namibia in 1995, are a common property resource management institution (Jones 2010). Conservancies allow the local people to benefit financially from wildlife through tourism and hunting.

We surveyed 361 households. Given that the approximate rural population of the regions sampled is 202 000 (Kafidi 2011) and the average household size (based on our study) is 9 people, we surveyed round 1.6% of the total population of this area (See Appendix 1 to see how this was calculated). We targeted households of livestock farmers because they are key players for vulture conservation in these areas, given that the primary threat to vultures in Namibia is the use of poison by farmers to control livestock predators. The majority ( $n = 261$ ) of the farmers were surveyed on their farms. Farmers were selected using a systematic approach, a route was chosen and approximately every 10 kilometres we would stop to speak

to a farmer (Kelley et al. 2003). Often, we would drive off the main road to reach a farm. The remaining surveys not done at the farm ( $n = 100$ ), took place at agricultural shops, using a convenience sampling technique (Kelley et al. 2003; Santangeli et al. 2016). This approach allowed us to gather more data efficiently by minimising travelling costs.

Surveys were conducted in Afrikaans, Otjiherero, Damara, Oshiwambo and English. The same local field assistant acted as a translator during most surveys. Sampling in the central north, where people are mainly Oshiwambo speaking, was facilitated by a second field assistant more familiar with the local language than the primary field assistant. When approaching farmers at farms, almost all agreed to participate in our survey. Those who declined, did so because they were not involved with the farming or because they did not own livestock. Farmers in the agricultural shop declined to participate more often, mainly because they were busy. We explained the research topic to each farmer and told them that all their responses would be kept anonymous. Their consent was given verbally, when their consent was translated back to CAC, who would sign the consent form on their behalf. This study protocol was approved by the University of Cape Town ethics committee (Approval code: FSREC 044 – 2016). The map presented in this manuscript was created using QGIS (2.18.3) software (QGIS Development Team 2016) and ArcGIS 10.2 (ESRI 2013).

### **Survey design and method**

The seven survey questions (see Appendix 2) used to assess knowledge, attitudes and cultural beliefs around vultures were embedded within a larger survey (36 questions) where the primary aim was to assess the use of poison to control predators. In this paper, we focus primarily on the data collected from the seven questions on vultures as in Appendix 2. These

questions were strategically placed in the middle of the questionnaire to ensure that farmers were at ease when answering them. The questions were placed after general questions about livestock and farming challenges, but before sensitive questions relating to lethal predator control and poisoning. In this manner when we got to the vulture questions the farmers had had time to get comfortable speaking to us.

We began by assessing farmers' attitudes towards vultures and the usefulness of vultures. To do this we provided two statements and asked people to respond to them using a 5- point Likert scale with the options being strongly disagree, disagree, neutral, agree, strongly agree. We then asked farmers to elaborate on their positive or negative attitudes. Before engaging farmers in conversations about vulture conservation it is useful to first understand what their impression of the population is. To assess the farmers' local knowledge of vultures we asked a question about vulture diet and a question about their perceptions of the population trend of vultures. It is difficult to make any deductions on actual vulture population trends based on farmers observations, especially given that vultures move in relation to food availability. However, the aim of this question was mainly to gauge farmers perceptions of the health of the local vulture population. We only posed this question to those who had lived in the area 5 years or longer. We asked farmers if they had witnessed any vulture mortalities to gain insight into the threats facing vultures on communal farmlands. Identification of the dead vultures were made by asking households for a description of the bird, Lappet-faced Vultures *Torgos tracheliotos* were identified by their red face and large size and White-backed Vultures *Gyps africanus* with their white patch on the rump and brownish colouration. We included two open-ended questions to learn about beliefs around vultures and cultural uses for vulture body parts.



## **Results**

### ***Farmers' knowledge of vulture diet and population trends***

The majority (88%, n =361) of households surveyed reported that vultures eat dead animals only. Of those households who reported that vultures killed their livestock (9%, n =36), 66% reside in the Damaraland region, the lower part of north-western Namibia. The remaining 3% of farmers reported that vultures eat live wild animals (1%) or they do not know what vultures eat (2%)

Of the households who had lived in the area for over 5 years (n =308), 56% said they do not know the vulture population trend because vultures were in the area sporadically (for food) or because they had not taken note of the number of vultures. Of those who had noticed trends in the vulture population over the last 5 years (n =136), 50% thought that the population had decreased, 32% thought they had increased and 18% thought the number had not changed. Of those who provided reasons for a change in population (n =74), the main reasons provided for the decrease in population were: drought (41%), emigration to areas with more food (13%), poisoning (10%) and food shortage (6%). Conversely the main reasons given for an increasing population were: 'nothing kills vultures' (16%), and during the drought there are more carcasses for them to feed on (12%).

### ***Attitudes towards vultures & their value to farmers***

Two thirds of the households surveyed (n =361) indicated that they liked vultures (63%) and they find them useful (68% of households). With these questions, we pooled the responses for strongly agree/agree and strongly disagree/disagree (see the five Likert scale answer levels in the questionnaire of Appendix 2) as we found that almost all farmers either strongly agreed or

strongly disagreed with the statements, very few farmers used the agree/disagree options (average 8.5% between the two statements). The reasons for liking vultures were often related to their usefulness. Of those who provided examples of vulture usefulness/uselessness (n = 255), 74% stated that they use vultures to locate dead livestock, 14% valued vultures' role in cleaning the environment, 1.5% saw the value of vultures to tourism and a further 1.5% thought vultures were useful for educational purposes, for spotting poachers and for fulfilling a role in the ecosystem. Conversely reasons stated for vultures being useless included vultures kill livestock (7% of households) and they steal meat (2%). Of those who provided reasons for liking or disliking vultures (n = 286), 40% stated that they were harmless, 19% found them useful for spotting dead livestock, 16% liked to see them because of their intrinsic value (God's creature, beautiful creature, good for conservancy to have wildlife), 5% found them useful for cleaning the environment and 3% found them useful for education and valued their role in the ecosystem. The minority of households who did not like vultures were either scared of them (1%), reported that vultures killed their stock (10%) or got to the carcasses before they could (6%). Two per cent of households did not know what vultures were and 4% of households said they never see vultures in their area.

### ***Causes and extent of local vulture mortalities***

Nineteen (5%) of all the households that we surveyed reported a total of 40 vulture mortalities (33 unidentified, four Lappet-faced Vultures and three White-backed Vultures in the last five years. According to farmer reports, three of these mortalities were due to the vultures choking on meat, 17 were killed at a poisoned carcass, seven where the cause was uncertain but was likely due to poison (dead vultures were found near a carcass), one was hit by a car, one got trapped within a carcass, one was killed by a dog and the remaining 10 died of unknown causes. Upon meeting with a number of conservancy staff across the study area

we heard about a few cases of poisoned vultures but in a couple of cases, these were not recorded adequately and had not been reported.

### ***Beliefs and cultural uses of vultures***

The majority (89%, n = 327) of households surveyed had never heard of any cultural beliefs concerning vultures. Those who had heard of cultural beliefs usually indicated that these beliefs were more widespread among the older generations. In some cases, we heard about the same belief multiple times from different households (Table 1). Seven different households reported that witchdoctors procure a special stick from vulture nests which has many powers. These beliefs are not unique to certain ethnic groups, the aforementioned belief was mentioned by Herero, Himba and Ovambo households (Table 1). Most of the beliefs that we heard about were reported by Himba (n =14) and Herero (n =10) households.

Few households (9.5%, n = 357) had heard of cultural uses for vulture body parts, with many saying that it was more common in previous generations. Half of these indicated that it is feathers that are used, mainly for arrows. The use of feathers was reported across multiple ethnic groups including: Damara, San, Herero, Himba and Ovambo. Other uses are detailed in Table 2. Uses for vulture body parts were most often reported by Ovambo (n =8) and Herero (n =8) households.

## **Discussion**

Overall, we found that Namibia's communal farmers have a positive perception of vultures. Vultures were seen to be harmless creatures and were useful to many farmers that we

surveyed. The main service that vultures provide is signalling the presence of dead livestock in the field. Cultural beliefs about vultures and cultural uses for their body parts were seldom reported. Thus, we believe that cultural use of vulture parts poses a minimal threat to vulture populations in north-western and central Namibia.

For the most part, communal farmers like vultures and find them useful. In addition, most are aware of and appreciate the ecosystem services that vultures provide. Similar observations were made in surveys with commercial farmers in Namibia and Spain and communal farmers in the Maasai Mara (Reson 2012; Santangeli et al. 2016; Morales-Reyes et al. 2017). Those who liked vultures described them as ‘harmless’ as they did not pose any threat to their livelihood and in some cases proved useful to them. Many farmers made use of vultures when looking for livestock that were missing and were presumed to have died in the field, a service which humans have used for a long time (Moleón et al. 2014). Communal farmers in the Maasai Mara and the Eastern Cape of South Africa, as well as commercial farmers in Namibia, are also known to use vultures for this purpose (Reson 2012; Pfeiffer et al. 2014; Santangeli et al. 2016). Some farmers acknowledged the usefulness of vultures in disposing of carrion. This is a service that has also been shown to be useful to Namibian commercial farmers (Santangeli et al. 2016), Spanish livestock farmers (Morales-Reyes et al. 2017) and Eastern Cape communal farmers, with the Eastern Cape farmers referring to vultures as their ‘free municipality’ (Pfeiffer et al. 2014).

A minority of farmers did not like vultures because they were concerned about vultures killing their livestock. While vultures are regarded as obligate scavengers, reports of predation have been reported in Spain and Kenya (Zuberogitia et al. 2010; Margalida et al. 2011; Reson 2012). In Spain between 2006 and 2010, 1165 farmers reported that Griffon

Vultures *Gyps fulvus* killed their livestock, usually during the spring birthing time (Margalida et al. 2011, 2014). In comparison, the issue of vulture predation in Namibia appears quite minor. Most of the reports of vulture predation in the present study came from the Damaraland region which may either indicate a change in behaviour of vultures in this area or a community misconception in this region. It is also possible that these few farmers see eagles and vultures as the same thing, thereby explaining the farmers' perception that vultures predate on small livestock. Furthermore vultures and eagles frequently scavenge on the same carcasses which may contribute to misidentification of eagles as vultures (Kane et al. 2014). Further investigation is needed to clarify this matter. It must be noted, however that these farmers represent a minority, as most farmers surveyed reported that vultures eat dead animals only. Another reason that communal farmers expressed dislike for vultures was that vultures eat all the meat before they can get to it. At the time of this study Namibia had been experiencing a severe drought for the past four years and many farmers were struggling. Given the circumstances, animosity towards vultures for 'stealing' their meat is not surprising.

Farmers' perceptions of vulture population trend were mixed. Of those who had noted the numbers of vultures, half thought that vultures were decreasing. Santangeli et al. (2016) found commercial farmers to express a similar mixture of opinions when it came to vulture population trends in their area, with over a third of farmers believing that vultures were increasing in Namibia. Based on farmers' anecdotal observations, perceived vulture population trends differ according to region and circumstances. For example, perceived increases could be due to a neighbouring vulture restaurant which draws more vultures to the area (Santangeli et al. 2016). This local knowledge is purely anecdotal and tells us little about actual population trends but it is nonetheless useful in highlighting local people's perceptions

of vulture populations in the area. Awareness campaigns which draw attention to the global and continental decline in vulture populations would be of value. Even though vulture populations may be increasing or stable in some regions, on a broad scale they are in decline (Ogada et al. 2016) and it is important for farmers to be aware of this.

A few farmers reported vulture mortalities, most of these mortalities were due to poisoning. Poisoning has been identified as the main cause for the collapse of Africa's vulture populations and in Namibia it is definitely the primary threat facing vultures (Botha et al. 2012; Santangeli et al. 2017). It is also the primary threat to vultures in Europe, particularly in Spain where over 8000 poisoning were reported over 20 years (Margalida 2012). Poisoning arises directly from conflict between livestock farmers and predators. Livestock farmers in some areas experience high levels of conflict with predators, particularly in conservancies where wildlife (including predator) populations have recovered (Stander 2006; Brown 2011; Naidoo et al. 2011a, 2011b). For some farmers, poisoning is seen as the most effective and easiest method to control predators. Santangeli et al. (2016) found that around 20% of commercial farmers in Namibia are using poison to control predators. A study is currently underway to quantify poison use by communal farmers and this will clarify the extent of poison use in these areas (Craig, Thomson, Girardello and Santangeli, in prep).

Cultural beliefs and the use of vulture body parts were seldom reported by the farmers. The farmers we surveyed viewed these beliefs and practices as outdated. Of the few beliefs mentioned, some could be beneficial for vulture conservation. For example, the belief that touching a vulture would result in a curse could be a protective belief for the species. In contrast, the belief that vultures carry curses may inspire animosity towards them. This has been seen in parts of South Africa, Malawi and Costa Rica where owls are believed to be

carriers of bad luck and death and as a result some people kill them out of fear (Enriquez & Mikkola 1997; Thompson et al. 2013).

The cultural use of vulture body parts is an important threat to African vulture populations, particularly in West Africa (Williams et al. 2014; Ogada et al. 2016). In Namibia, however, few communal farmers had heard of cultural uses for body parts. Of those who had heard of uses for vulture body parts, feathers were the most popular part used. This is similar to what Hengari et al. (2004) found when speaking with traditional healers in Windhoek. A farmer informed us that feathers are collected from the ground at vulture feeding sites. It is uncertain whether all people procure feathers in this way but this particular method poses little threat to the vulture population. Of greater concern is the collection of the ‘special stick’ in vulture nests for use in traditional medicine as this could result in chick mortalities and impact on breeding success. Nonetheless, this practice seems to be rare and not likely to pose a serious threat overall.

### ***Conclusions and implications for vulture conservation***

Our study shed light on farmers’ perceptions of vultures and the local practices and traditions that could pose a threat to vultures. The reports of poisoning mortalities are concerning, especially since the reports that we heard of were almost certainly underestimated. Conservancies need to be encouraged to record poison mortalities in detail and to report them timeously. This will help authorities to act quickly to reduce the impact of a poisoning event. Such timely interventions are particularly effective when field staff are specifically trained to respond to poisoning events (Murn & Botha 2017). Most importantly, our findings confirmed that communal farmers, similar to commercial farmers, have an overall positive perception towards vultures. These findings highlight the potential for conservancies to focus on vulture

conservation. Raising awareness about vulture conservation and bringing vultures into the realm of ecotourism could enhance existing tourism in communal conservancies, providing it is done in a sensitive manner which does not disturb vultures and breeding sites (Sekercioglu 2002). This will ultimately benefit local livelihoods and give vulture conservation the attention it so needs.

## **Acknowledgements**

We are very grateful to every farmer who participated in this research. We thank Ndapanda Kasaona and Ndina Hapinge for their translation services in the field. We are grateful to Liz Komen, Chris Brown, Holger Kolberg, the MET, Annatjie du Preez, NACSO, Basilia Shivute, Teo Ntinda, Andrew Malherbe, Vince and Edgar Naude, Timm Hoffmann and Jane Turpie for their advice and support while planning and implementing this research. We thank the National Research Foundation and Department of Science and Technology of South Africa, the British Ecological Society, Mohamed bin Zayed Species Conservation fund (Project number: 142510056) for funding the field work for this research. Lastly, we thank the Agra stores in Opuwo, Omaruru, Khorixas and Outjo for allowing us to survey in their stores.

## **References**

- Anthwal A, Gupta N, Sharma A, Anthwal S, Kim KH. 2010. Conserving biodiversity through traditional beliefs in sacred groves in Uttarakhand Himalaya, India. *Resources, Conservation and Recycling* **54**:962–971.
- Beilis N, Esterhuizen J. 2005. The potential impact on Cape Griffon Gyps coprotheres populations due to the trade in traditional medicine in Maseru, Lesotho. *Vulture News* **53**:15–19.
- Berkes F, Colding J, Folke C. 2000. Rediscovery of traditional ecological knowledge as adaptive management. *Ecological Applications* **10**:1251–1262.



- Botha AJ, Ogada DL, Virani MZ. 2012. Proceedings of the Pan - African Vulture Summit 2012. Proceedings of the Pan - African Vulture Summit 2012:1–47.
- Brown CJ. 2011. An analysis of Human Wildlife Conflict in the ≠ Khoadi // Hoas Conservancy for the period 2007 to June 2011:1–15.
- Colding J, Folke C. 2001. Social Taboos : “ Invisible ” Systems of Local Resource Management and Biological Conservation. *Ecological Applications* **11**:584–600.
- Costanzo M, Archer D, Aronson E, Pettigrew T. 1986. Energy conservation behavior: The difficult path from information to action. *American Psychologist* **41**:521–528.
- Devault TL, Rhodes OE, Shivik JA. 2003. Scavenging by vertebrates: behavioral , ecological , and evolutionary perspectives on an important energy transfer pathway in terrestrial ecosystems. *Oikos* **102**:225–234.
- Diaz S et al. 2015. The IPBES Conceptual Framework — connecting nature and people. *Environmental Sustainability* **14**:1–16.
- Donázar JA et al. 2016. Roles of Raptors in a Changing World: From Flagships to Providers of Key Ecosystem Services. *Ardeola* **63**:181–234.
- Enriquez P., Mikkola H. 1997. Comparative Study of General Public Owl Knowledge in Costa Rica, Central America and Malawi, Africa. Pages 160–166 in J. Duncan, D. Johnson, and T. Nicholls, editors. *Biology and conservation of owls of the Northern Hemisphere: 2nd International symposium*. U.S. Dept. of Agriculture, Forest Service, North Central Forest Experiment Station.
- ESRI. 2013. Arc GIS release 10.2. Redlands, CA.
- Hengari GM, Cunningham PI, Adank W. 2004. The use of vultures by traditional healers in Namibia. *Vulture News* **50**:23–28.
- Houston DC. 1986. Scavenging Efficiency of Turkey Vultures in Tropical Forest. *The Condor* **88**:318–323.
- Jones B. 2010. The Evolution of Namibia’s Communal Conservancies: The Politics of Natural Resource Governance in Africa. Pages 106–120 in F. Nelson, editor. *Community rights, conservation & contested land*. Earthscan, Abingdon.
- Kafidi L. 2011. Namibia 2011 Population and Housing Census.
- Kane A, Jackson AL, Ogada DL, Monadjem A, McNally L. 2014. Vultures acquire information on carcass location from scavenging eagles. *Proceedings of the Royal Society B: Biological Sciences* **281**:1–7.
- Kelley K, Clark B, Brown V, Sitzia J. 2003. Good practice in the conduct and reporting of survey research. *International Journal for Quality in Health Care* **15**:261–266.

- Margalida A. 2012. Baits, Budget Cuts: A Deadly Mix. *Science* **338**:192–194.
- Margalida A, Campion D, Donazar JA. 2011. European vultures' altered behaviour. *Nature* **480**:457.
- Margalida A, Campion D, Donazar JA. 2014. Vultures vs livestock: conservation relationships in an emerging conflict between humans and wildlife. *Oryx* **48**:172–176.
- Markandya A, Taylor T, Longo A. 2008. Counting the Cost of Vulture Declines – Economic Appraisal of the Benefits of the Gyps Vulture in India 1. *Ecological Economics* **67**:1–39.
- Mckean S, Mander M, Diederichs N, Ntuli L, Mavundla K, Williams V, Wakelin J. 2013. The impact of traditional use on vultures in South Africa. *Vulture News* **65**:15–36.
- Milcu AI, Hanspach J, Abson D, Fischer J. 2013. Cultural ecosystem services: A literature review and prospects for future research. *Ecology & Society* **18**:44–88.
- Moleón M, Sánchez-Zapata JA, Margalida A, Carrete M, Owen-Smith N, Donázar JA. 2014. Humans and Scavengers : The Evolution of Interactions and Ecosystem Services. *Bioscience* **64**:394–403.
- Morales-Reyes Z, Martín-lópez B, Moleón M, Mateo-tomás P, Botella F, Margalida A, Donázar JA, Blanco G, Pérez I, Sánchez-zapata JA. 2017. Farmer perceptions of the ecosystem services provided by scavengers : what , who and to whom. *Conservation Letters* **Early View**:1–24.
- Morelli F et al. 2015. The Vulture in the Sky and the Hominin on the Land : Three Million Years of Human – Vulture Interaction. *Anthrozoös* **28**:449–468.
- Murn C, Botha A. 2017. A clear and present danger: impacts of poisoning on a vulture population and the effect of poison response activities. *Oryx*:1–7.
- Naidoo R, Stuart-Hill G, Weaver LC, Tagg J, Davis A, Davidson A. 2011a. Effect of diversity of large wildlife species on financial benefits to local communities in northwest Namibia. *Environmental and Resource Economics* **48**:321–335.
- Naidoo R, Weaver LC, De Longcamp M, Du Plessis P. 2011b. Namibia's community-based natural resource management programme: an unrecognized payments for ecosystem services scheme. *Environmental Conservation* **38**:445–453.
- Ogada D et al. 2016. Another Continental Vulture Crisis: Africa's Vultures Collapsing toward Extinction. *Conservation Letters* **9**:89–97.
- Ogada DL, Keesing F, Virani MZ. 2012a. Dropping dead : causes and consequences of vulture population declines worldwide. *Annals of the New York Academy of Sciences* **1249**:57–71.
- Ogada DL, Torchin ME, Kinnaird MF, Ezenwa VO. 2012b. Effects of Vulture Declines on

- Facultative Scavengers and Potential Implications for Mammalian Disease **26**:453–460.
- Pfeiffer MB, Venter JA, Downs CT. 2014. Identifying anthropogenic threats to Cape Vultures *Gyps coprotheres* using community perceptions in communal farmland, Eastern Cape Province, South Africa. *Bird Conservation International* **25**:1–13.
- Prakash V, Pain DJ, Cunningham AA, Donald PF, Prakash N, Verma A. 2003. Catastrophic collapse of Indian white-backed *Gyps bengalensis* and long-billed *Gyps indicus* vulture populations. *Biological Conservation* **109**:381–390.
- QGIS Development Team. 2016. QGIS Geographic Information System. Open Source Geospatial Foundation Project.
- Reson E. 2012. Assessing Maasai Attitudes and Perceptions Toward Vultures : a Case Study of Resident Maasai Around Maasai Mara National. MSc Thesis: Clemson University.
- Santangeli A, Arkumarev V, Komen L, Bridgeford P, Kolberg H. 2017. Unearthing poison use and consequent anecdotal vulture mortalities in Namibia’s commercial farmland – implications for conservation. *Ostrich* **88**:147–154.
- Santangeli A, Arkumarev V, Rust NA, Girardello M. 2016. Understanding, quantifying and mapping the use of poison by commercial farmers in Namibia - Implications for scavengers’ conservation and ecosystem health. *Biological Conservation* **204**:205–211.
- Schultz PW. 2012. Conservation Means Behavior. *Conservation Biology* **25**:1080–1083.
- Sebastián-González E, Moleon M, Gibert J, Botella F, Mateo-Tomás P, Olea P, Guimaraes JR P, Sanchez-Zapata JA. 2016. Nested species- rich networks of scavenging vertebrates support high levels of interspecific competition. *Ecology* **97**:99–105.
- Sekercioglu CH. 2002. Impacts of birdwatching on human and avian communities. *Environmental Conservation* **29**:282–289.
- Simmons RE, Brown CJ, Kemper J. 2015. Birds to watch in Namibia: red, rare and endemic species. National Biodiversity Programme, Windhoek.
- Stander P. 2006. Population ecology and demography of Kunene lions, 2006: Towards resolving human-lion conflicts with applied research and pro-active management. Predator Conservation Trust: Windhoek.
- Stern PC. 2000. Toward a Coherent Theory of Environmentally Significant Behavior. *Journal of Social Issues* **56**:407–424.
- Thompson LJ, Hoffman B, Brown M. 2013. Causes of admissions to a raptor rehabilitation centre in KwaZulu-Natal, South Africa. *African Zoology* **48**:359–366.
- Williams VL, Cunningham AB, Kemp AC, Bruyns RK. 2014. Risks to Birds Traded for African Traditional Medicine : A Quantitative Assessment. *PLoS ONE* **9**:1–17.

Zuberogitia I, Martínez JE, Margalida A, Gómez I, Azkona A, Martínez JA. 2010. Reduced food availability induces behavioural changes in Griffon Vulture *Gyps fulvus*. *Ornis Fennica* **87**:52–60.

**Table 1:** The cultural beliefs that farmers reported about vultures, including the number of farmers reporting the belief and the ethnic group of these farmers

<b>Belief</b>	<b>No. farmers reporting</b>	<b>Ethnic groups</b>
Witchdoctors can procure a special stick from a vulture's nest which has many magical properties and is considered lucky. To get this stick, the witchdoctor will tie a vulture chick to the tree with a piece of string, it is believed that the adult will use a stick to untie the chick, this stick will then be collected	7	Herero, Himba, Ovambo
Vultures mean rain is coming	5	Damara, Himba, Kavango
Vultures can be a bad omen if they are behaving unusually	3	Himba, Herero, Damara
Witchdoctors use vultures as carriers for curses	2	Herero
Vultures breeding indicate that drought is coming	2	Damara, Herero
Just so story: francolins make a noise when vultures are feeding because at creation vultures were given the wings that the francolins were supposed to get	2	Himba
It is bad luck to touch a vulture and doing so can give you an incurable illness which you will pass on to future generations	1	San
The eye of a dead animal communicates with the vulture, if you do not want a vulture to find the carcass you should poke the dead animal's eye out	1	Himba

**Table 2:** The uses of vulture parts as reported by farmers, including the number of farmers reporting the use and the ethnic groups of these farmers

Use	No. farmers reporting	Ethnic groups	
Claws for decorative purposes	2	Herero	5
Bones, claws and beak used in traditional medicine- they have healing properties	2	Herero, Himba	6
Vulture claws to scratch open a sick child's skin to release the sickness	2	Ovambo	8
A child holding a vulture skull can predict the future	1	Ovambo	10
Holding a vulture kidney on a child's skin to cure disease	1	Damara	12
The vulture skin is worn by boys going to get circumcised	1	Ovambo	14

**Appendix 1: The subsection of the questionnaire used to collect the data for this study**

**Vultures: beliefs, knowledge and attitudes**

I am going to say a statement: Strongly agree, somewhat agree, neutral, somewhat disagree, strongly disagree

21.) I like to see vultures in this area \_\_\_\_\_

a.) "Can you tell me why you agree/disagree with this?" \_\_\_\_\_

22.) Vultures are useful to have in this area \_\_\_\_\_

a.) "Can you tell me why you agree/disagree with this?" \_\_\_\_\_

23.) Are there any beliefs about vultures in your  
culture? \_\_\_\_\_

24.) Do vulture body parts have any uses in your culture? \_\_\_\_\_

a.) If yes... What for? \_\_\_\_\_

25.) What is the main thing that you see vultures eating? \_\_\_\_\_

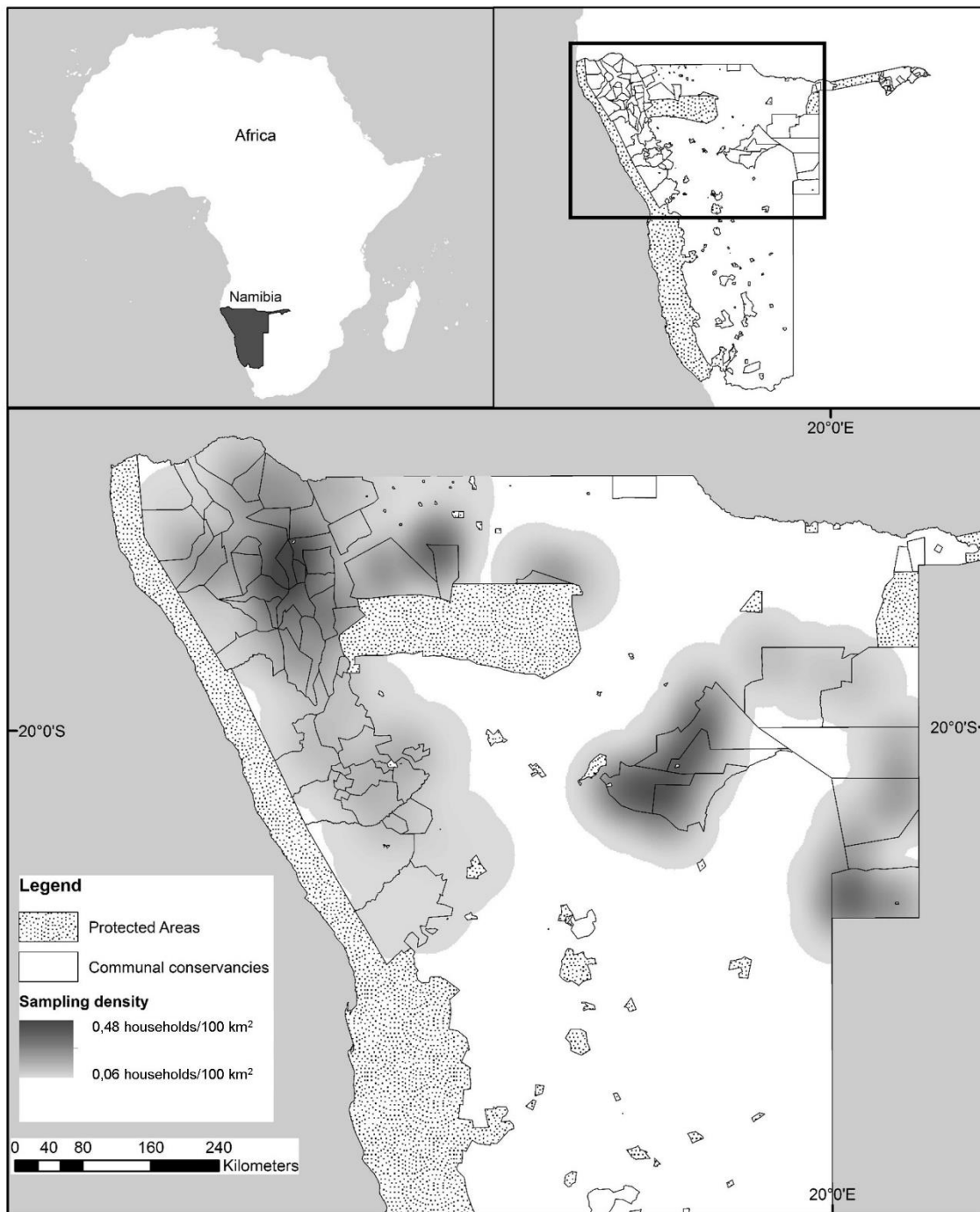
26.) In the last five years have the number of vultures in this area:

Decreased: \_\_\_\_\_ Increased: \_\_\_\_\_ Stayed the same: \_\_\_\_\_

a.) Why do you think this is? \_\_\_\_\_

27.) In the last five years have you seen any dead vultures in this area?

a.) Yes \_\_\_\_\_ No \_\_\_\_\_ b.) How many? \_\_\_\_\_ c.) How did they die? \_\_\_\_\_



**Figure 1:** The density of the households sampled across the study region and the location of all registered communal conservancies. Spatial layers from NACSO (2016b), accessed from EIS (2016) and (Flannery 2014)